הטכניון מכון טכנולוגי לישראל TECHNION Israel Institute of Technology

הפקולטה להנדסת מכונות Faculty of Mechanical Engineering

SEMINAR - סמינר

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות, שתתקיים ביום ב' 25.01.21 (י"ב בשבט תשפ"א), בשעה 14:30 באמצעות הזום:
https://technion.zoom.us/j/93295991944

מרצה:

Dr. Andrea Cioncolini
Senior Lecturer, Department of Mechanical, Aerospace and Civil Engineering
University of Manchester, UK

על הנושא:

Pragmatic Modelling of Annular Two-Phase Flow for Demanding Cooling Applications

The seminar will be given in English

להלן תקציר ההרצאה:

The lecture focuses on annular flow, one of the most important flow regimes in gas-liquid and vapor-liquid two-phase flows in tubes and channels. In the annular flow, a thin liquid film flows adjacent to the channel wall, surrounding a gas or vapor core that flows in the channel centre and carrying entrained liquid droplets. The shear stress of the gas or vapor core continuously atomizes the liquid film. In parallel the entrained liquid droplets are continuously deposited back onto the liquid film after being accelerated in the gas or vapor core, which flows faster than the liquid film. This continuous liquid exchange between the film and the gas or vapor core imposes a tight mass and linear momentum coupling between the phases that makes analysis and modelling of annular flows particularly challenging.

Practical applications, where accurate modelling of annular two-phase flows is crucial for a sound design and safe equipment operation include air conditioning and refrigeration systems, chemical processing plants, microscale heat sinks used in thermal management of microelectronics circuits and high-energy particle detectors, high heat flux cooling applications, such as nuclear fission and fusion reactors, and power electronics.

This lecture will present a mechanistic modeling suite for annular flow that the author has been developing over the last years. Presently, the annular flow modeling suite includes methods for predicting the gas/vapor void fraction, the entrained liquid fraction, the wall shear stress and the associated frictional pressure gradient and the average liquid film thickness. Moreover, the modeling suite contains an algebraic turbulence model for momentum and heat transfer through the liquid film that allows prediction of heat transfer coefficient during convective evaporation and condensation. Notably, this algebraic turbulence model represents a change in turbulence modeling paradigm of shear-driven thin liquid films, from a simple extrapolation of existing single-phase flow theories to a new modeling approach that considers a thin liquid film as a fluid-bounded flow. All prediction methods included in the annular flow modeling suite are semi-empirical minimal models, designed using simple physical arguments and calibrated with experimental data. The predictive accuracy of these models is comparable or better than that of the widely used empirical correlations. The underlying experimental databank presently contains 11,000+ data points collected from 100+ literature studies that cover conventional and micro-channels, circular and non-circular geometries, and several fluids including water and refrigerants. The unified annular flow modeling suite is still in progress, and current/future developments include upgrading of the pressure drop and heat transfer models, and also a new model of dryout during convective evaporation.

מארח: פרופ' מיכאל שפירא

בברכה,

פרופ"ח מתי' סוכו
מרכז הסמינרים